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09/847,605	05/01/2001	Karl Jacob Haltiner JR.	DP-302846	7187

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EXAMINER
ALEJANDRO, RAYMOND

ART UNIT	PAPER NUMBER
1745	

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7

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/847,605	HALTINER ET AL.	
	Examiner	Art Unit	
	Raymond Alejandro	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10 and 23-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10 and 23-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 May 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☒ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's cancellation of Group II (claims 11-22) in Paper No. 6 is acknowledged.

Priority

2. Acknowledgment is made of applicant's claim for domestic priority under 35 U.S.C. 119(e). Accordingly, this application is claiming the benefit of a prior filed provisional application S/N 60/201569.

Oath/Declaration

3. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because:
It does not clearly identify the citizenship of each inventor. *In this regard, it is noted that the citizenship of second inventor (Mr. Subhasish Mukerjee) has been identified as "Citizenship: IN". However, the examiner recognizes that under WIPO Standard Country Codes, the country code "IN" refers to India, if such interpretation is intended by the applicant please make appropriate statement, otherwise further clarification of said citizenship is herein requested.*

Drawings

4. The drawings filed on 05/01/01 have been accepted.

Claim Language Suggestions

5. Claims 5 (line 3) and 24 (line 6): it is suggested to change the recitation "the cathode gas stream" to "the cathode gas flow" so as to have a better understanding of the claims.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claim 7 recites the limitation "the projected area" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 1-2, 5, 8-9, 23-24, 28-29 are rejected under 35 U.S.C. 102(e) as being anticipated by Badwal et al 6280868.

The instant application is directed to an interconnect for fuel cell elements wherein the disclosed inventive concept comprises its particular configuration. Other limitations include the specific contact points; the flow passages; the surface area; the coatings/layers; the through passages; in addition, a fuel cell stack assembly comprising the interconnect is claimed.

With respect to claims 1 and 23:

Badwal et al disclose an electrical interconnect device for a planar fuel cell having a solid oxide electrolyte, a cathode, and an anode (ABSTRACT); said interconnect containing substrate having fuel gas-flow channels one side and an oxidation-resistant coating on surfaces of the anode said adapted to contact the anode (ABSTRACT). The interconnects 20, 22 are identical with an array of gaseous fuel channels extending across the underside 26 and array of gaseous oxidant flow channels 28 extending across the top side 30 (col 5, lines 14-18). The interconnect device comprises a plate-like chromium containing substrate (col 3, lines 27-28); the interconnect should have a relatively high electrical conductivity (col 2, lines 15-17). *Thus, the substrate (single base) is conductive.* It is further disclosed that cleaning the interconnect surface by etching is performed prior to application of the metal layer (col 4, lines 35-41). *Since the interconnect surface is cleaned by etching, it is thus considered that the interconnect per se is an etched interconnect.*

It is further disclosed that by providing the gas flow channels on both sides, the interconnects 20, 22 may be used to form a fuel cell stack in which an identical fuel cell 12 overlies the interconnect 20 and another identical fuel cell 12 underlies the interconnect 22. Further identical interconnects may then be placed adjacent the opposite sides of the further fuel cells, and so forth to build up a fuel cell stack of the desired number of fuel cells (col 5, lines 21-

30/col 1, lines 35-38). *Thus, the anode and cathode gas flow passages have a geometry selected to provide fuel and oxidant gas flow according to system operation.* It is also disclosed that gas flow paths are provided between the interconnect and respective electrodes (col 1, lines 36-38). *Thus, the interconnect per se comprises gas flow channels which provides appropriate and satisfactory gas flow.*

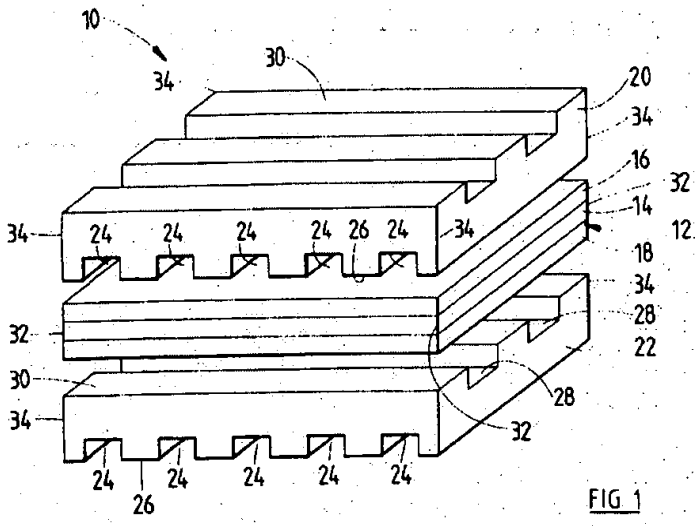


FIG 1

Figure 1 above illustrates a fuel cell assembly 10, the assembly comprises a fuel cell 12 comprising a solid oxide electrolyte central layer 14 with an anode layer 16 overlying one face of the electrolyte and a cathode layer 18 overlying the opposite face of the electrolyte. The fuel is sandwiched between a pair of interconnects 20, 22 which in use are in face contact with the anode 16 and cathode 18, respectively.

As for claim 2, 24:

Figure 1 above depicts interconnects 20, 22 comprising gas flow channels 24 and 28. As can be appreciated from Figure 1, the interconnect comprises a plurality of top side surfaces 30 and underside surfaces 26 closely spaced to each other which act as contact points between the interconnect and electrode and wherein said top side surfaces 30 and underside surfaces 26 have

small dimensional diameters. *It is noted that the term "diameter" has been construed as the length of a straight line through the center of an object regardless of any specific geometric configuration.*

As to claim 5, 24:

It is disclosed that gas flow paths are provided between the interconnect and respective electrodes (col 1, lines 36-38). *Thus, the interconnect per se comprises gas flow channels which provides appropriate and satisfactory gas flow.* It is disclosed that the purpose of the interconnect is to convey to convey heat away from fuel cells (col 5, lines 60-63/col 1, lines 11-16). The interconnect should have a relatively high thermal conductivity to provide improved uniformity of heat distribution (col 2, lines 19-21).

As to claim 8-9, 28-29:

It is further disclosed that the interconnect device has an oxidation-resistant coating on surfaces of the one side adapted to contact the anode (ABSTRACT/ Col 3, lines 25-35) wherein the coating comprises an outer oxygen barrier layer for electrically contacting the anode comprising Ni, a noble metal or an alloy thereof; and an electrically conductive metal barrier layer between the substrate and the outer layer (ABSTRACT/ Col 3, lines 25-35). *Thus, the electrically conductive metal barrier layer enhances electrical conductivity at the anode/interconnect interface; and the oxidation-resistant coating, in general, which is adapted to contact the anode conforms the surface of the interconnect to the fuel anode.*

Thus, the claims are anticipated.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. Claims 3-4 and 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Badwal et al 6280868 as applied to claims 1, 2 and 5 above, and further in view of Ruhl et al 6361892.

Badwal et al is applied, argued and incorporated herein for the reasons above. However, Badwal et al do not disclose: a) the specific contact point density, shape and diameter; and b) the specific flow passage depth and surface area.

With respect to claims 3-4:

Ruhl et al disclose one embodiment wherein at least one separator defines a micro-channel pattern (col 2, lines 57-59) and/or the separator surface has a plurality of columns extending therefrom, said columns defining variable cross-section micro-channels therebetween

(col 3, lines 16-20). It is disclosed that the separator contacts the surface of one of the electrodes opposite the electrolyte (col 2, lines 56-57). *Thus, the separator acts as an interconnect.*

Figure 2A below shows a separator 6 defining microchannels 26 on either or both of its surfaces. Since the separators contact the anode and cathode surfaces, microchannels 26 defined within the separator surfaces provide reactant channeling (col 6, lines 33-40). A microchannel 26 may be defined by a quantity of regularly spaced circular columns 34 (*contact points*) extending between surfaces (col 6, lines 45-48). It is disclosed that it should be understood that a preferred pattern of columns 34 would utilize many more columns than shown, with each column having a diameter on the order of about 1 mm or less (col 6, lines 58-61/col 7, lines 48-52). The cell and stack diameters are typically about 50 to about 80 mm (col 5, lines 10-12). *The specific contact point density is apparent upon inspection of the separator plate 6 as illustrated in Figure 2A.*

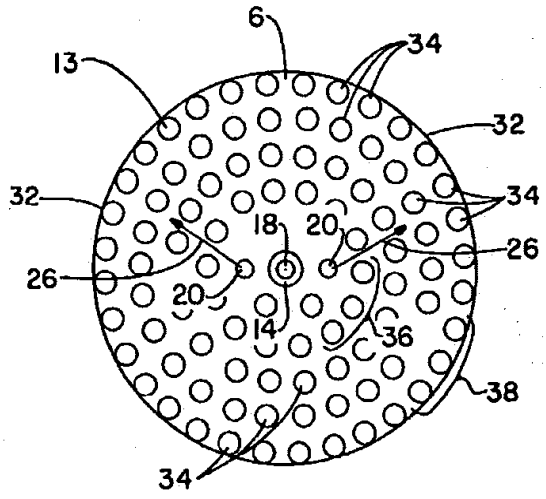


FIG.-2A

With respect to claims 6-7:

It is disclosed that the depth of the microchannels 26 may comprise substantially the entire thickness of the electrode 13 (col 6, lines 63-65). It is further disclosed that the depth of

the micro-channel is generally on the order of about 0.1 to about 0.5 mm, although the micro-channel can be as deep as the thickness of the electrode layer. It is also disclosed that the crossflow channels in the separator has a depth "c" on the order of 1 mm (col 8, lines 53-67).

It is further disclosed that the height (h) of each column 34 is generally on the order of about 0.05 mm to about 0.4 mm (col 6, lines 61-63). The width of the micro-channel is generally on the order of about 0.1 to about 0.5 mm (col 8, lines 55-56). Thus, ***the specific surface area ratio between the flow passages surface area and the projected area*** is apparent based on the disclosed magnitudes of column diameter and height; and width and height of the channel. Accordingly, *the surface area of a cylinder* (column or projected area) can be determined as follows: $\mathbf{A_{surface\ cylinder} = 2\pi r^2 + 2\pi rh}$ (where r is the radio of the circular column and h is the column height); and the surface area of the flow channel can also be determined as follows: $\mathbf{A_{surface\ rectangle}}$ **= height x width**.

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to make the contact points on the interconnect of Badwal et al by having the specific contact point density, shape and diameter of Ruhl et al because Ruhl et al teach that flow channel dimension, shape and contact percentage can be customized and controlled through the channel design for enhancing reactant distribution of the cell. Accordingly, those of ordinary skill in the art would find motivation to make the specified contact point density in the interconnect of Badwal as it is evident from Ruhl et al's teaching that a preferred pattern of columns would utilize many more columns than shown in the simplified figure (see col 6, lines 58-60). Thus, the preferred pattern may be designed to control flow distribution within a cell by defining pathways that offer reduced resistance in comparison with the surrounding material

wherein the flow distribution may be further controlled by the number, size or arrangement of the micro-channels within the cell. The preferred pattern is designed with consideration to the column spacing and the contact area percentage. Further, those of ordinary skill in the art would find motivation to make the specific contact point shape in the interconnect of Badwal et al as Ruhl et al teaches that columns (contact point) of different geometries may be utilized to provide customized flow characteristics so that reactant gas flowing though the shaped channel achieves tailored local flow, pressure and velocity distributions. Moreover, those of ordinary skill in the art would have motivation to make the specified contact point diameter in the interconnect of Badwal et al as Ruhl et al disclose that the preferred pattern utilizes column having the specific diameter which help to minimize the cell pressure drop, to achieve a good gas velocity, thereby preventing the surrounding gas mixture from diffusion backward into the cell. Accordingly, the diameter of the columns and their contact area percentage would be selected as a compromise between minimizing electrical resistance, achieving good reactant gas distribution to and from the active electrode sites, achieving the target pressure drop with a minimum pattern thickness and fabrication limitations.

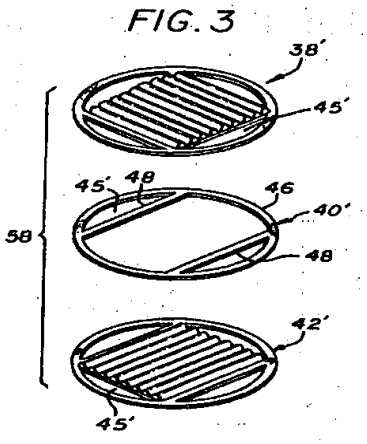
With respect to the specific flow passage depth and the surface area, it would have been obvious to one skilled in the art at the time the invention was made to make the interconnect of Badwal et al by having specified flow passage depth and surface area of Ruhl et al because Ruhl et al teaches that the specific depth of flow passage (channel) and surface area relationship should defines a channel pattern wherein the channel cross-section is enhanced such that reactant gas flowing through the passages (channel) achieves tailored local flow, pressure, and velocity distributions. Accordingly, those of ordinary skill in art would find motivation to make the

specified flow passage depth and surface area relationship in the interconnect of Badwal et al as Ruhl et al teaches that such flow passage depth and surface area relationship (overall dimension), in general, achieve a specific target overall pressure drop that minimize electrical resistance and improves reactant gas distribution.

14. Claim 10 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Badwal et al 6280868 as applied to claims 1 and 23 above, and further in view of Minh et al 5256499.

Badwal et al is applied, argued and incorporated herein for the reasons above. In addition, Badwal et al do not expressly disclose the specific manifolds comprising through passages arranged along outer perimeter of the interconnect.

Minh et al disclose manifolds of a solid oxide fuel cell which are integrally formed with the fuel cell's core; the fuel cell includes an interconnect wherein the interconnect is provided with cutouts that define manifold passageways for the fuel and oxidant (ABSTRACT). ***Figures 2D and 3*** show interconnects 38 and 38' having through passages along outer perimeters thereof and one cell unit wherein through passages are aligned and matched to form an assembled fuel cell unit.



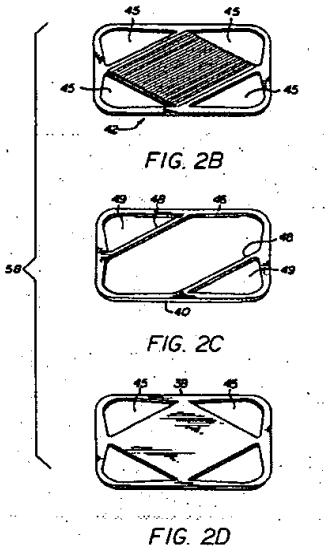


FIG. 2B

FIG. 2C

FIG. 2D

In view of these disclosures, it would have been obvious to one skilled in the art at the time the invention was made to make the specific manifolds comprising through passages arranged along outer perimeter of the interconnect of Badwal et al as taught by Minh et al as Minh et al teach that an interconnect design with integral gas manifolds is desirable because fuel cell core design with integral gas manifold minimize stringent tolerance requirements for stack hardware design. Accordingly, mechanical stability and structural integrity is improved by using the specific integral manifolding assembly of fuel cells having multiple, stacked individual cells. *It is further noted that Badwal et al's teaching also encompass fuel cell arrangements having either external or internal (integral) manifolding configuration.*

15. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Badwal et al 6280868 as applied to claim 23 above, and further in view of Hsu 6024859.

Badwal et al is applied, argued and incorporated herein for the reasons above.

Badwal et al also teach that an external manifolding arrangement as possible options for the gaseous fuel and oxidant (col 1, lines 47-49).

However, Badwal et al do not disclose the specific external stamped sheet metal manifolds.

Hsu discloses an electrochemical converter which is preferably a fuel cell such as a solid oxide fuel cell (col 6, lines 60-65); wherein the textured pattern of the top and bottom of the interconnector plate can be obtained by stamping metallic alloy sheets (col 10, lines 11-15) wherein the gas passages networks are formed and the manifolds is formed in the interconnector plate (col 10, lines 20-25).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to make the specified external stamped sheet metal manifolds in the external manifolding of Badwal et al because Hsu teaches that stamped metallic alloy sheets can be used for manifolding purposes because the stamping method is capable of producing articles of varied and complex geometry while maintaining uniform material thickness. Thus, a suitable external stamped metal manifold having uniform material thickness and satisfactory geometry is obtained.

16. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Badwal et al 6280868 as applied to claim 23 above, and further in view of Fraioli 4510212.

Badwal et al is applied, argued and incorporated herein for the reasons above. However, Badwal et al do not disclose the interconnect being fused to the fuel cell.

Fraioli discloses solid oxide fuel cells (title) wherein all active core materials including the anode, the cathode, the electrolyte (the fuel cell components) and the interconnect are integrally fused together (Col 10, lines 21-25/Claims 2-3 and 12).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to fuse the interconnect to the fuel cell of Badwal et al as taught by Fraioli as Fraioli teaches that fuel cell components including the anode, the cathode, the electrolyte and the interconnect are fused together to make a fuel cell core construction integrally joined or connected together. Thus, mechanical stability and structural integrity of the fuel cell structure is enhanced. Further, this fused structure would minimize the effects of differential thermal expansion across the surfaces of each fuel cell component constituting the entire fuel cell structure.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (703) 306-3326. The examiner can normally be reached on Monday-Thursday (8:30 am - 7:00 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on (703) 308-2383. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Raymond Alejandro
Examiner
Art Unit 1745